How to cite this paper:

Wan Fatimah Wan Ahmad, Ahmad Sobri Hashim, & Aaina Nadia Mazlan. (2017). Development of mobile application for autistic children using augmentative and alternative communication technique in Zulikha, J. & N. H. Zakaria (Eds.), Proceedings of the 6th International Conference of Computing & Informatics (pp 262-267). Sintok: School of Computing.

DEVELOPMENT OF MOBILE APPLICATION FOR AUTISTIC CHILDREN USING AUGMENTATIVE AND ALTERNATIVE COMMUNICATION TECHNIQUE

Wan Fatimah Wan Ahmad [1], Ahmad Sobri Hashim [2], and Aaina Nadia Mazlan [3]

Computer and Information Sciences Department
Universiti Teknologi PETRONAS,
32610 Bandar Seri Iskandar, Perak
{fatimhd[1], sobri.hashim[2]}@petronas.com.my, aainanadia@gmail.com[3]

ABSTRACT. Communication is essentially a perfect approach to start and end everyday life routines. It is exceedingly critical to maintain one's life whether it is verbal or nonverbal communication. As the number of autistic children is increasing, the children experience in having problems in communication. Furthermore, there is a lack of mobile learning application in Malay on speech and language. The objective of this paper includes reporting on the development and evaluation of user acceptance of an Android based application using Augmentative and Alternative Communication technique. *Suara Saya* is a developed mobile application which will act as a learning-based and communication-based application. Rapid Application Development methodology has been applied in the development. The tools used include Android Studio, Unified Modeling Language (UML) and Adobe. User acceptance testing has been conducted to 13 participants which consist of speech therapists, teachers and parents. A survey has been conducted after they have gone through the application. Results have shown that the teachers and parents are willing to use the app for their children and they believed that the usage of mobile phones will benefit children with autism.

Keywords: mobile application; augmentative and alternative communication; autism

INTRODUCTION

The Literacy and Numeracy (LINUS) programme was introduced as a focus area of the education National Key Results Area (NKRA) of the Government Transformation Programme (GTP) (GTP, 2013). The objective of the program is to offer an established and strong foundation in basic literacy and numeracy skills during the first three years of the Malaysian schooling system. There are three times screenings per year in order to identify students who are facing difficulties in reading, writing and basic arithmetic. The identified students will have to participate in a LINUS-dedicated remedial class hoping that their performance will be improved. It is important to identify the students that have problems at an early stage before they are way behind the classmates.

Speech and language disorders or difficulties refer to problems in communication and related areas such as oral motor function (Bishop, 2014). These delays and disorders range from

simple sound substitutions to the inability to understand or use language or use the oral-motor mechanism for functional speech and feeding. Some causes of speech and language disorders include hearing loss, neurological disorders, brain injury, intellectual disabilities, drug abuse, physical impairments such as cleft lip or palate and vocal abuse or misuse. Language disorders may be related to other disabilities such as intellectual disabilities, autism or cerebral palsy. It was estimated that approximately 1 in 150 children has been diagnosed with Autism Spectrum Disorder (ASD) (NASM, 2013). Then, the rate of ASD prevalence rose up to 1 in every 110 children in the year 2009 and doubled in the year 2013.

Lower order thinking is the foundation of skills required to move into higher order thinking. These are skills that are taught very well in school systems and include activities like reading and writing. In lower order thinking, information does not need to be applied to any real life situations, it only needs to be recalled and slightly understood. There is a prevailing conception that students must learn facts and procedural knowledge before they can later engage in so-called 'higher-order' thinking skills. Therefore, there should be a learning and communication source for children that have problems with lower order thinking skill.

Most of the autism centre in Malaysia are using teaching style through the use of visual cards and strip module books. Therapist or teachers will show pictures one by one or step by step and explain details of the pictures. Since Malay language is the national language in Malaysia, developing mobile apps in Malay language can help teachers, therapist and even parents in the teaching process. The objectives of this paper include reporting on the development and the evaluation on the user acceptance of a mobile application for autistic children using Augmentative and Alternative Communication (AAC) technique.

LITERATURE REVIEW

Autism is categorized as a pervasive, life-long developmental disorder in which the child affected experiences severe and pervasive impairment in several areas of development (Camarata, 2014). There are three main characteristics of autistic children: impairment with social interaction, impairment in communication and the presence of restricted, repetitive and stereotypical patterns of behavior (WHO, 2013). Communication is one of the key qualities of life defining skills in which the autistic children are lack of (Duffy & Healy, 2011). According to (Gudu, 2015), children with autism are experiencing in language ability which make them hard to express what they need. Therefore, it is essential to help these children in creating their relational abilities.

Augmentative and Alternative Communication (AAC) has been implemented for children and adults in communicating especially for those who cannot consistently depend on functional communication (Beukelman & Mirenda, 2005). It is a set of strategies that expand, improve and enhance communication skills for non-verbal and verbal autistic children (Beukelman & Mirenda, 2005). AAC also has been used as to compensate lack of functional speech, require adaptive tools and equipment. It also allows a child to use every mode possible in communicating the messages and ideas. With the abilities of AAC that can be changed over time, therefore, the system can be revised to suit the users (Visvader, 2013). AAC systems of communication do not rely on speech. For some children, an AAC may be the primary means of communication; others may use an AAC to clarify and expand their speech. AAC systems are categorized in several ways. According to (Voorn & Kommers, 2013), autistic children have difficulties with abstract concepts and have greater ability to learn by rote than symbolism and analogy. Bloom taxonomy has been used in creating the developing the content. For this project, the author focuses on the lower order thinking skills which consists of applying, understanding, and remembering. There are three lower order thinking skills which include understanding, remembering and applying (Voorn & Kommers, 2013). According to Bloom's taxonomy (Voorn & Kommers, 2013), example of social interaction activities is demonstrating. While understanding means constructs the meaning from instructional materi-

al including oral, written and graphical communication. Remembering consists of memorizing, repeating and recalling. The project focuses on the lower order thinking skills which consists of applying, understanding and remembering. Since technology can offer tools to support the learning, a mobile application has been developed using AAC in order to assist the autistic children in communication.

Information and Communication Technology (ICT) is widely used in today's education field. School is an important environment in which students participate in a wide range of computer activities, while the home serves as a complementary site for regular engagement in a narrower set of computer activities (Bolic et al., 2013). ICT is being applied increasingly and successfully in instruction, learning, and assessment. A number of previous studies have shown that an appropriate use of ICT can raise educational quality and connect learning to real-life situations (Van Weert, 2005). As stated, learning is an ongoing lifelong activity where learners change their expectations by seeking knowledge, which departs from traditional approaches. As time goes by, they will have to expect and be willing to seek out new sources of knowledge.

There are some existing mobile application in the app store. JABtalk is a free Android speech communication designed to help non-verbal children and adults to communicate (JABTalk, 2016). However, users complained that the functions are difficult to use, does not come with vocabulary and not really stable as the system often crash. Gabby Tabs is a kid friendly augmentative communication app delivered by parents of non-verbal child with autism (Gabby Tabs, 2016). Gabby Tab helps and encourages children to communicate at home, in school and on the go. However, users will have to buy for a full version and they cannot customize their own category of learning. Another available app is TabToTalk (TabToTalk, 2016). This free app allows users to choose among different sets of AAC albums based on the needs of non-verbal child or adult. Different albums are available in different languages such as English, Spanish, French, German and Italian. However, this app only display one board at a time. The "capture and record" feature is not available in-app. Users will have to go online to customize the categories and the available template is also limited.

METHODOLOGY

In designing this application, Rapid Application Development has been adapted because it relies on rapid prototyping and allows developer to test the prototype rapidly. This life cycle consists of several stages namely as analysis and quick design, prototypes cycle, testing and deployment. The prototype has been developed using Java language and Android studio. The developed prototype is named Suara Saya. Once the prototype has been developed, a user acceptance testing has been conducted. User acceptance testing has been conducted to 13 participants which consist of speech three therapists, five teachers and five parents. They were given the applications whereby each of them will have to go through and play around with the application. An observation will be conducted while they were using the application. Each session took about 30 minutes per person. Once they have gone through the application, then a set of questionnaire was given to them. The questionnaire consists of Likert scale from 1 (strongly disagree) to 5 (strongly agree) and was adopted from System Usability Scale (SUS) (Brooke, 2013). The questions are on the usability mainly on user friendless, user interface, interface, learnability and effectiveness.

RESULTS

Suara Saya mobile application is a free AAC talker application which supports communication in all areas of life, and therefore provides voices for children with speech and language difficulties. The app is specially designed in Bahasa Malaysia. The target users for this mobile application are therapist, teachers, parents, children with speech and language disorder, and autistic children.

Table 1 shows the mapping of lower order thinking skills cognition that can fit in the characteristic of autistic children. By doing this, people with lower order thinking skills problem can also use this apps. Based on the mapping, it is shown that children with LOTs problem can be included in all of the three main characteristics of autism which are understanding, remembering and applying. For understanding, the children will be able to construct the meaning such as demonstrating and showing. Remembering, consists of memorizing, repeating and recalling. While applying involves carrying out or using the procedure in a given situation using learned knowledge.

Table 1. Mapping LOTs To Characteristics Of Autism

Characteristics	Lower Order Thinking Skills Cognition		
	Applying	Understanding	Remembering
Social Interaction	X		
Communication		X	
Behaviours			X

Figure 1 shows the activity diagram of the overall system of Suara Saya mobile application. Firstly, user needs to enter his/her name. After entering name, user will be directed to the homepage screen. At the home screen, user will have to choose two main functions, either 'kategori' (category) or 'template'. For 'kategori' functionalities, users can view the images and play sounds. They can even add new images to 'kategori'. For users choosing 'template', they can firstly, choose number of template, either 2, 4, or 6. After choosing number of template, they can add pictures from category to the template. The database function is to display to user, and also update all pictures and sound that have been added by user.

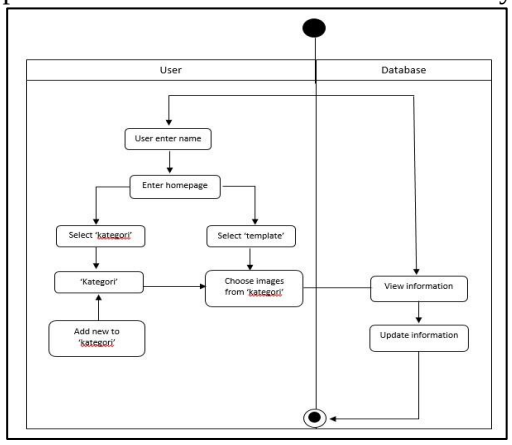

Figure 1. Activity diagram.

Suara Saya Mobile Application

Suara Saya Mobile Application is developed on an Android platform by using Android Studio. Figure 2 will appear as the Startup page of *Suara Saya* mobile application. In this page, user is required to enter his/her name to be displayed on the Home page. Figure 3 shows the interface of the Home page. This is the page where user can choose to select the main function of the application. It is either 'KATEGORI' or 'TEMPLATE'. The two buttons will lead the user to two different pages. Figure 4 shows the interface of the "KATEGORI" page. There are 6 basic categories available which are communication, food, object, feelings, verbs, and questions. These categories will test on their remembering and understanding. User can also add new custom category by selecting the "TAMBAH BARU" (add new) button. In this case, the categories are not limited to only 6 categories. Back button is also available in case the user wants to go back to the previous page. By using Suara Saya mobile application, users can record their voices. Users can also playback and listen what they have recorded. This will then support the LINUS programme in terms of literacy and can be used in the remedial class

to improve on their performance by incorporating vocabulary learning into all classroom activities.

Figure 2. Startup Page **Figure 3. Home Page** **Figure 4. KATEGORI Page**

Figure 5 shows the result of mean score of the user acceptance test. In general, the respondents stated that this mobile application could help them in preparing the module of learning easily. The results is inline with social communication, emotional regulation and transactional support (SCERTS) which empowers expansive educational approach that gives an opportunity and succession of dynamic objectives by focusing noteworthy, reasonable advancement inside everyday schedules at school, home and in the general public (Prizant et al. 2003). Other comments from users include that the application consists of several features, users can choose the number of template, and users can also add their own custom category complete with their own photo and voice recording function.

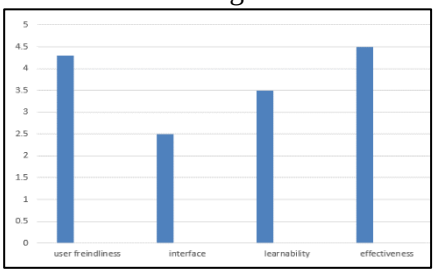

Figure. 5 User Acceptance Result

CONCLUSION

Suara Saya is an Augmentative and Alternative Communication mobile application designed for autistic and children with communication or speech language problem. *Suara Saya* which uses the AAC approach has enabled autistic children to communicate using the application. Furthermore, users can also add new words with custom photo and sound to the categories available. This mobile application is an offline application where users can use this application using any model of smartphone without having the internet connection. Throughout the findings, *Suara Saya* mobile application has successfully been developed to show the available functionalities. It can also provide speech and language learning opportunities in different contexts.

In the future, this mobile application needs to be improved by adding more functionality in order to add more benefits to its users. One of the function that is possible to be added is to enable user to save the template that has been created. In this case, if user wants to reuse the template module, he/she wouldn't have to redo template and expand target user group so that this mobile application can help other disabilities. Other than that, an improvement of the user interface could be made to make the mobile application more attractive and fun. Lastly, a

variation of compatibility and availability to other platform such as IOS should also be added to expand the usage of this mobile application.

REFERENCES

Bishop, D. V. M. (2014). Ten questions about terminology for children with unexplained language problems. *International Journal of Language & Communication Disorders*, *49*(4), 381-415.

Beukelman, D., & Mirenda, P. (2005). Augmentative and alternative communication: Supporting children and adults with complex communication needs.

Bolic, V., Lidström, H., Thelin, N., Kjellberg, A., & Hemmingsson, H. (2013). Computer use in educational activities by students with ADHD. *Scandinavian journal of occupational therapy*, *20*(5), 357-364.

Brooke, J. (2013). SUS: A retrospective. Journal of usability studies, 8(2), 29-40.

Camarata, S. (2014). Early identification and early intervention in autism spectrum disorders: Accurate and effective? *International Journal of Speech-Language Pathology*, *16*(1), 1-10.

Duffy, C., & Healy, O. (2011). Spontaneous communication in autism spectrum disorder: A review of topographies and interventions. *Research in Autism Spectrum Disorders*, *5*(3), 977-983.

GabbyTab. (2016). Available online: https://play.google.com/store/apps/details?id=com.techunlimited.gabbytabs.android.full.english&hl=en

GTP report (2013). Available online: https://www.pmo.gov.my/dokumenattached/NTP-Report-2013/GTP_2013_ENG_Report.pdf.

Gudu, B. O. (2015). Teaching Speaking Skills in English Language Using Classroom Activities in Secondary School Level in Eldoret Municipality, Kenya. *Journal of Education and Practice*, *6*(35), 55-63.

JABTalk. (2016). Available online: https://play.google.com/store/apps/details?id=com.jabstone.jabtalk.basic

National Autism Society of Malaysia. (2013). What is Autism? [Online]. Available: http://www.nasom.com.my/index.php.

Prizant, B. M., Wetherby,A.M., Rubin, E., Laurent, A.C. (2003). The SCERT Model, A Transactional, Family-centered Approach to Enhancing Communication and Socioemotional Abilities of Children with Autism Spectrum Disorder. Infants and Young Children, Vol 16, No 4, pp 296-316.

TabToTalk. (2016). Available online: http://www.autismpluggedin.com/2011/06/autism-aac-ipad-app-taptotalk-review.html.

Van Weert, T. J. (2005). *Information and communication technologies and real-life learning: new* education for the knowledge society (Vol. 182). Springer Science & Business Media.

Visvader, P. (2013). AAC Basics and Implementation: How to Teach Students who talk with Technology. Assistive Technology Team, Boulder Valley School District, Boulder, CO.

Voorn, R. J., & Kommers, P. A. (2013). Social media and higher education: introversion and collaborative learning from the student's perspective. *International Journal of Social Media and Interactive* Learning Environments,1(1), 59-73.

World Health Organization. (2013). Autism Spectrum Disorders & Other Developmental Disorders. *From raising awareness to building capacity. Geneva: WHO Document Production Services.*